Syllabus
Atmospheric Physics II (PHYS 622) 2014

3 credits
Tuesday and Thursday 8:30-9:45 AM
Math and Psychology Building, Room 105

Instructors

Dr. Benjamin Johnson (301-614-6804, jbenjam@gmail.com)
Dr. Tamás Várnai (301-614-6408, varnai@umbc.edu)

Course objective

Introduction to terrestrial atmospheric physics with emphasis on atmospheric radiative transfer, and aerosol and cloud physics.

Required text book*

Petty, G. W.: A Short Course in Cloud Physics. Sundog Publishing. 2nd ed.

Recommended books*

Rogers, R. R., and Yau, M. K.: A Short Course in Cloud Physics. Pergamon Press, 3rd ed.
Wallace, J. M, and Hobbs, P. V.: Atmospheric Science: An Introductory Survey. 2nd ed.
Salby, M. L.: Fundamentals of Atmospheric Physics. 1st ed.

Course outline

1) **Atmospheric Radiative Transfer: Basic concepts**
   a) Fundamental radiometric definitions and terms
   b) Blackbody radiation
      i) Kirchoff's law
      ii) Planck's law
      iii) Application to bodies not in thermodynamic equilibrium
   c) Molecular absorption
      i) Summary of important absorbing gases in the atmosphere
      ii) Descriptive summary of molecular absorption principles (vibration-rotation, etc.)
      iii) Overview of spectral line shapes
   d) Extinction, absorption, and scattering
      i) Beer's law
      ii) Radiative properties of atmospheric scatterers
      iii) The radiative transfer equation and methods to solve it
      iv) Atmospheric optics

* You may contact Benjamin Johnson about the best options for book purchases.

2) Atmospheric Aerosols

a) Introduction to atmospheric aerosols
   i) Importance in atmospheric processes
   ii) Description of mechanical generation of salt and dust particles
   iii) Gas-to-particle conversion
   iv) Sulfate and nitrate particles
   v) Carbon and other particles
   vi) Radiative properties
b) Size distributions
   i) Measured and analytic
c) Evolution of size distributions
   i) Homogeneous nucleation (nucleation mode)
   ii) Growth: diffusion, coagulation, kinematic, cloud processing (accumulation mode)
   iii) Removal: settling, impaction, collision with cloud and precipitating particles (coarse mode)
d) Aerosol measurements
   i) In-situ and remote sensing
e) Aerosols and climate
   i) Global aerosol distributions, impacts of aerosols and their changes

3) Clouds

a) Warm cloud processes
   i) Cloud droplet microphysics (homogenous/heterogeneous nucleation, Kelvin equation, solute effect, CCN)
   ii) Droplet growth by condensation
   iii) Initial cloud droplet size distributions (CCN spectrum measurements, effect of CCN on cloud droplet concentration)
   iv) Droplet coagulation and warm cloud precipitation processes
b) Ice cloud processes
   i) Homogeneous/heterogeneous nucleation, ice nuclei
   ii) Ice particle growth by deposition
   iii) Crystal habits
   iv) Riming, aggregation, breakup
c) Cloud measurements
d) Clouds and climate

Grading
Homework 30%
Student presentation on a research topic 30%
Mid-term and final exams (2 x 20%) 40%

Student Presentations
Each student will give a presentation in class on a research topic of their choice in an area related to the course.
Topics must be submitted by March 15, and the presentations will take place during the last class or classes in May.

Schedule
Classes Begin: January 28
Spring break: March 17-21
Last class: May 13

The classes will be divided roughly equally between the three main segments: Radiation, Aerosols, and Clouds.

A few lectures may be presented by guest lecturers (JCET, Goddard, or visiting scientists with expertise in relevant areas).